

# Reaction-Controlled Diffusion

PI: Uwe C. Täuber, Virginia Tech, DMR-0075725

## Research:

Reaction-diffusion systems model a large variety of problems in physics, chemistry, biology, and ecology.

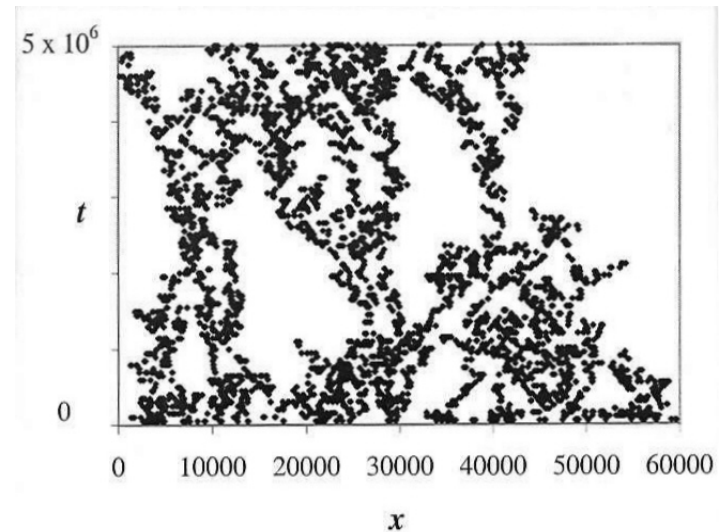
They provide an ideal venue for integrated teaching and research involving undergraduate students.

We have studied the anomalous diffusion of passive random walkers 'A' on spatio-temporal fractal structures that emerge at a non-equilibrium active to absorbing state transition of reacting agents 'B'.

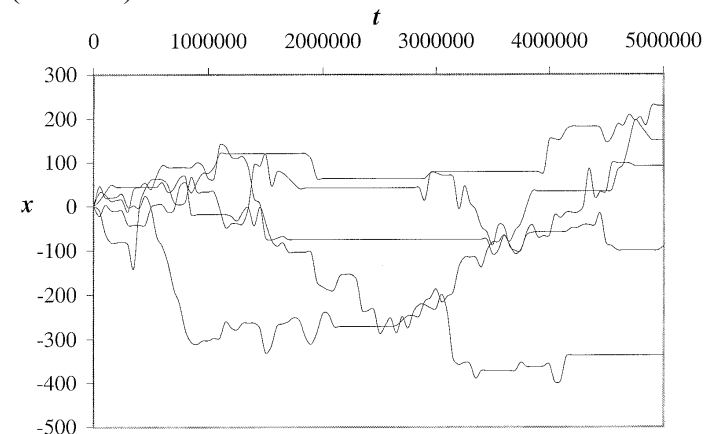
One possible application envisions infectious virus (A) propagation in a carrier population (B) that is set close to an extinction threshold.

Physics undergraduate student **Beth A. Reid**, with the aid of mathematics undergraduate Jason C. Brunson, performed extensive numerical simulations for various B reaction schemes, and then compared the A particle propagation with analytic results from a simple mean-field theory.

Beth A. Reid, Uwe C. Täuber, and Jason C. Brunson, *Phys. Rev. E* **68**, 046121 (2003).



Fractal cluster in space  $x$  and time  $t$ , emerging at the critical point of branching ( $B \rightarrow 3B$ ) and annihilating ( $2B \rightarrow 0$ ) random walkers B.



The paths of the five fastest A particles propagating on the fractal backbone shown in the picture above.

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## Education:

For her B.S. honors *thesis* project, **Beth A. Reid** received the Society of Physics Students' 2003 *Outstanding Student Award for Undergraduate Research*, and was named a finalist for the American Physical Society's 2003 *LeRoy Apker Award*.



Beth Reid also obtained an *NSF graduate fellowship* and now pursues her Ph.D. in theoretical biophysics at Princeton University.

The PI has incorporated the physics of non-equilibrium systems into his undergraduate and graduate classes on statistical mechanics and condensed matter theory.

## Outreach:

During visits at Tall Oaks Montessori School and Blacksburg Middle School, the PI explained the use of mathematics and computer technology in science. The PI arranged visits by physics undergraduates participating in the department's outreach program to Tall Oaks Montessori School, Blacksburg, VA.



Beth Reid demonstrates angular momentum to lower elementary school students at Tall Oaks Montessori School.